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2,288,831

ENGINE ROCKER ARM

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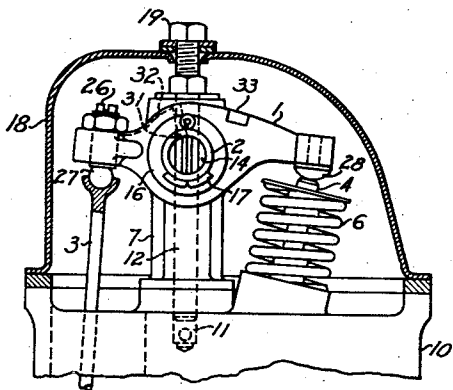


Fig. 1

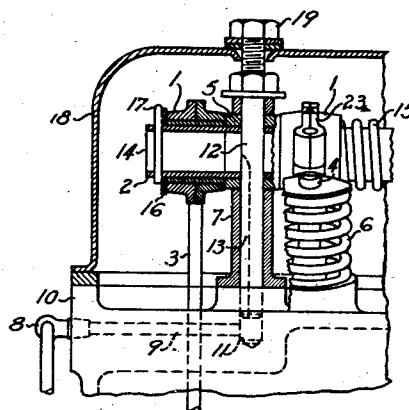


Fig. 2

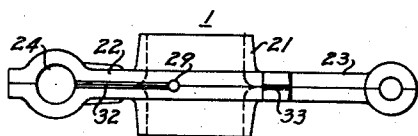


Fig. 3

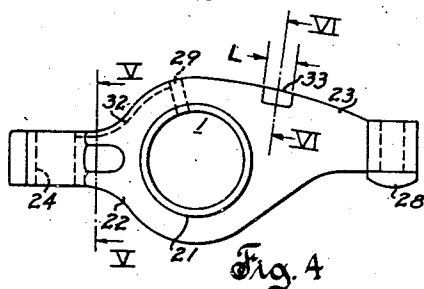


Fig. 4

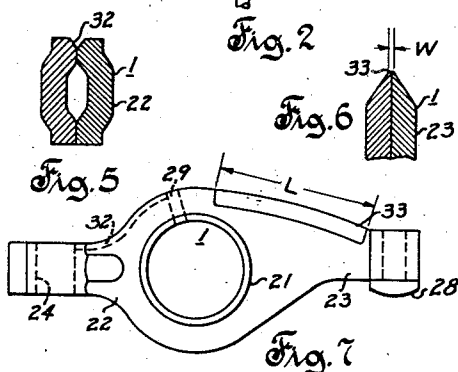


Fig. 5

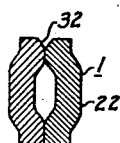


Fig. 6

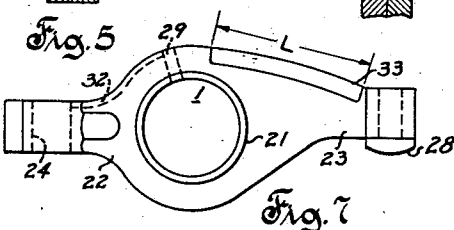


Fig. 7

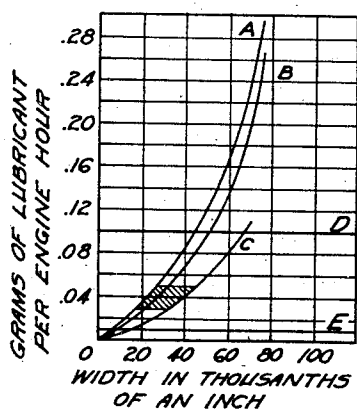


Fig. 8

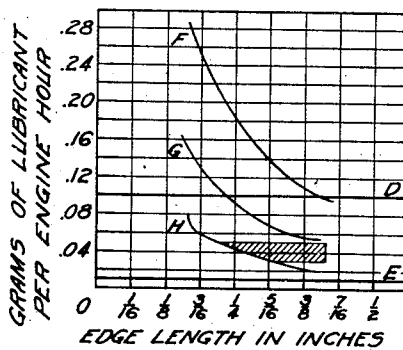


Fig. 9

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UNITED STATES PATENT OFFICE

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ENGINE ROCKER ARM

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8 Claims. (Cl. 184—6)

This invention relates generally to engine rocker arms and more particularly to the rocker arms employed in the overhead valve type of internal combustion engine.

In engines of this type, lubrication of the rocker arm and push rod assembly and of the valve stems actuated thereby is generally effected by employing a hollow rocker arm shaft having axially spaced transversely extending bores arranged for communication with a bore extending transversely through the hub portion of each of the rocker arms mounted on said shaft and by delivering lubricant under pressure into the interior of the hollow shaft whereby lubricant flows therethrough and out along the top surface of the rocker arm and then down onto the upper end portions of the associated push rod and valve stem. The lubricant which is thus transmitted to the valve stems flows downward on the stems and when the valve stem is moved downward to open the valve thereon, some of the lubricant will flow along the stem and into the engine cylinder where it is burned or otherwise wasted thereby unnecessarily increasing oil consumption. This action is particularly noticeable with respect to the intake valves since when an intake valve is opened the piston in the associated cylinder is moving downward which produces a high degree of suction which in turn accelerates the flow of lubricant into the cylinder.

The quantity of lubricant flowing through said bores and out onto the top surface of the rocker arm is determined by the pressure of the lubricant and by the size and arrangement of the said bores and attempts have been made to correlate the pressure of the lubricant, the size and arrangement of the said bores including the degree of communication effected by the movement of the rocker arm in order to control the quantity of lubricant flowing along the top surface of that portion of the rocker arm which engages the valve stem and thereby prevent an excessive consumption of lubricant. However, the control of the quantity of lubricant flowing to the valve stems by means of the aforementioned correlation has not been entirely satisfactory as it requires the use of relatively small bores which frequently become clogged and the result is insufficient lubrication and stuck push rods and valve stems. Attempts to overcome this defect by increasing the pressure of the lubricant has not solved the problem since a pressure sufficient to keep the bores clear at all times results in too much lubricant being forced out through the bores which in turn results in an excessive con-

sumption of lubricant as previously pointed out. Moreover, the use of a high pressure lubricating system is highly undesirable as it is conducive to leakage at numerous points throughout the system and in addition materially increases the initial cost of the engine.

The primary object of this invention is to provide an improved engine rocker arm construction which will entirely eliminate the aforementioned defects.

Another object of this invention is to provide an improved engine rocker arm construction which will positively control the quantity of lubricant that reaches the outer end of the valve stem actuating portion of the rocker arm from the hub portion thereof irrespective of the size and arrangement of the communicating bores in the rocker arm shaft and the rocker arm hub portion.

Still another object of this invention is to provide an improved engine rocker arm construction in that the top surface of the rocker arm along which lubricant flows in passing from the hub portion to the valve stem actuating end thereof is provided with means operative to prevent lubricant in excess of that required for satisfactory lubrication of the associated valve stem from reaching the valve stem actuating end of the rocker arm.

A further object of this invention is to provide an improved engine rocker arm construction in that the top surface of the rocker arm along which lubricant flows in passing from the hub portion to the valve stem actuating end thereof is provided with a relatively long and narrow lubricant flow control edge or surface over which the lubricant must flow in passing from the hub portion to the valve actuating end thereof.

The invention accordingly consists of the various features of construction, combinations of element and arrangements of parts as more fully pointed out in the appended claims and in the detailed description, in which:

Fig. 1 is a partial transverse section through an engine embodying the invention;

Fig. 2 is a partial longitudinal section of the engine shown in Fig. 1;

Fig. 3 is a plan view of an engine rocker arm embodying the invention;

Fig. 4 is a side elevation of the rocker arm shown in Fig. 3;

Fig. 5 is a transverse section through the rocker arm taken on line V—V of Fig. 4;

Fig. 6 is another transverse section of the rocker arm taken on line VI—VI of Fig. 4;

Fig. 7 is a side elevation of a rocker arm similar to that shown in Fig. 4; and

Figs. 8 and 9 are graphs showing lubricant flow curves obtained in accordance with this invention.

Referring to the drawing and particularly to Figs. 1 and 2, it is seen that the valve operating mechanism comprises a rocker arm 1 mounted for angular movement on a hollow rocker arm shaft 2 and a push rod 3. The upward movement of the push rod 3, which is preferably actuated in the usual manner by a cam means (not shown), effects an angular movement of the rocker arm 1 about the shaft 2 sufficient to effect a downward movement of the engaged valve stem 4 which in turn opens a valve (not shown). Upward movement of the valve stem 4 and closure of the associated valve (not shown) is effected by the compression spring 6 which was further compressed by the downward movement of the valve stem 4 and which acts to cause the push rod 3 to follow its actuating cam (not shown). This method of valve operation is well known in the art and a more detailed description in this connection is unnecessary for a complete understanding of the invention.

The hollow rocker shaft 2 is supported by suitable axially spaced supports 7 only one of which is shown and lubricant under pressure from a suitable source (not shown) is delivered to the interior of the shaft 7 by means of the pipe 8, the passage 9 in the cylinder head block 10 which communicates with the lower portion of the threaded stud bore 11, and the rocker arm support stud 12 which is provided with an axially extending groove 13, placing the lower portion of the threaded stud bore 11 in communication with the interior of the rocker shaft 2. The open end of the rocker shaft 2 is sealed against the escape of lubricant by a suitable plug means 14. The rocker shaft support 7 includes a shaft engaging sleeve 5 the opposite sides of which are engaged by the sides of the hub portions of the rocker arms 1. The rocker arm on the outer end of the shaft 2 is held with its hub portion abutting the sleeve 5 of the support 7 by means of the washer 16 and cotter pin 17. The cotter pin 17 also functions to retain the sealing 14 in the position shown. The rocker arm abutting the inner side surface of the sleeve 5 is held in this position by means of the usual compression spring 15. The valve actuating mechanism is enclosed by means of the cylinder head cover 18 which is removably secured to the cylinder head 10 by any suitable means such as the studs 19.

The rocker arms 1, which are preferably of stamped and brazed construction, as best seen in Figs. 3 and 4, each comprises a hollow hub portion 21 having oppositely extending push rod and valve stem engaging arms 22 and 23, respectively. The outer end of the push rod engaging arm 22 is enlarged and provided with a tapped bore 24 adapted to receive an adjusting screw 26 having a bulb-shaped end 27 which engages a socket in the upper end of the push rod 3 as shown in Fig. 1. The outer end of the valve stem engaging arm 23 is provided with a cam means 28 which engages the upper end of the valve stem 4 as shown in Figs. 1 and 2. The hub portion 21 is provided with a bore 29 which registers with a transversely extending bore 31 in the hollow rocker shaft 2 so that the lubricant delivered under pressure to the interior of shaft 2 will flow out through said registering bores and onto the outside top surface of that portion of the

hub portion 21 nearest the push rod 3. The top edge of the push rod engaging arm 22 is preferably provided with an oil conducting groove 32 which extends from the bore 29 to the tapped adjusting screw bore 24 in order that most of the lubricant issuing from the bore 29 will flow toward the push rod end of the rocker arm.

In accordance with this invention, the top edge of the arm 23 along which the lubricant for the associated valve stem normally flows in passing from the hub portion to the valve stem engaging portion thereof is provided with or shaped to provide a lubricant flow control operative to limit the quantity of lubricant which reaches the associated valve stem. The flow control means employed may vary considerably within the scope of this invention, but a preferred construction operative to produce this result consists, as best shown in Figs. 3, 4, 6 and 7, in providing the upper edge of the arm 23 with a relatively long and narrow lubricant flow control edge or surface 33 over which the lubricant must flow in passing from the hub portion to the valve stem engaging portion of the rocker arm. The rocker arm shown in Fig. 7 is similar to that shown in Figs. 3 and 4 and since the only difference is in the length of the lubricant flow control edge or surface employed, like numerals are used to designate the corresponding parts of this structure. The description of Figs. 3 and 4 is applicable in all respect to the structure shown in Fig. 7 and therefore a further description in this connection is believed unnecessary for a complete understanding of the invention.

When an engine is relatively new no appreciable quantity of the lubricant flowing down the valve stem enters the engine cylinder as there is only a slight tolerance between the valve stem and the wall of the bore in which the valve stem is guided to permit the reciprocating valve opening and closing movements thereof. However, when the valve stem and the guide therefor have worn sufficiently to produce a clearance therebetween of as little as five one-thousandths of an inch, a large portion of the lubricant flowing down the valve stem then enters the engine cylinder whereupon it is consumed or otherwise wasted which results in an excessive consumption of lubricant. Experiments in this connection have determined (1) that the quantity of lubricant which should be delivered to a single valve stem in order to insure satisfactory lubrication under all operating conditions is approximately 0.04 gram per hour of engine operation, (2) that when only 0.01 gram of lubricant per hour of engine operation is delivered to a valve stem, the result is marginal lubrication which invariably produces stuck valves, and (3) that when more than 0.10 of a gram of lubricant is delivered to a valve stem the result is excessive lubricant consumption. Consequently, it is necessary in order to insure proper and trouble free lubrication of the valve stems without effecting an excessive consumption of lubricant, that the quantity of lubricant delivered to each valve stem be controlled or metered by a means which operates irrespective of the pressure of the lubricant and irrespective of the size and location of the registering bores in the rocker shaft and the rocker arm hub portion.

Figs. 8 and 9 graphically illustrate the feasibility of accomplishing the desired result by the use of a relatively long and narrow flow control or metering edge or surface over which the lubricant must flow in passing from the hub

portion to the valve stem engaging portion of the rocker arm. Fig. 8 shows three curves A, B and C each representing the quantity of lubricant flowing over a relatively long and narrow flow control or metering edge or surface of fixed length, L, when the width, W, of such edge or surface is varied. These three curves were plotted from actual test data using the ordinates to represent the quantity of lubricant flowing to a single valve stem in grams per hour of engine operation and the abscissa to represent the width of the metering edge. The data for plotting curve A was obtained by using a metering edge $\frac{1}{8}$ of an inch long and by varying the width W from 0.018 of an inch to 0.675 inch. The data for plotting curves B and C was obtained by using metering edges $\frac{1}{4}$ and $\frac{1}{2}$ inch in length, respectively, and by varying the width of the edge as specified with respect to curve A. The shaded area on the graph represents the preferred range throughout which the quantity of lubricant can be varied without producing undesirable results. Line D represents the quantity of lubricant producing excessive oil consumption and line E represents the quantity of lubricant producing marginal or insufficient lubrication. Fig. 9 shows three curves F, G and H each representing the flow of lubricant obtained by using a metering edge or surface of fixed width, W, and varying the length, L, thereof. These curves were plotted by selecting a width, W, on the graph shown in Fig. 8 and obtaining the corresponding values on the curves A, B, C and plotting these results using the ordinates to represent the quantity of lubricant flowing to a single valve stem in grams per hour of engine operation and the abscissa to represent the length, L, of the metering edge or surface. The shaded area and lines D and E represent the same conditions as specified with respect to Fig. 8. Curve F was obtained using an edge width of 0.07 of an inch and curves G and H were obtained using edge widths of 0.05 and 0.03 of an inch, respectively.

From a consideration of the curves A, B and C of Fig. 8 and curves F, G and H of Fig. 9 it is readily seen (1) that when the length of the flow control or metering edge or surface is much less than $\frac{1}{8}$ of an inch even a knife edge will permit the passage of entirely too much lubricant and in this connection, actual tests have demonstrated this to be true when the length of the metering edge is as much as $\frac{1}{8}$ of an inch, (2) that when the width of the metering edge or surface is even as much as 0.067 of an inch the length of the metering edge or surface must be in excess of $\frac{1}{4}$ of an inch in order to prevent an excessive consumption of lubricant, and (3) that the best results are obtained using a metering edge or surface having a length width ratio, i. e., the length divided by the width, equal to or greater than four. The metering edge or surface 33 as shown in Figs. 3, 4, 6 and 7 is devoid of means operative to confine lubricant thereon, i. e. the edge or surface 33 has no appreciable impediment to the flow of lubricant from said surface in a direction transverse with respect to the direction the lubricant flows thereover in passing from the hub portion of the rocker arm to the valve stem engaging end thereof. Consequently, the lubricant passing thereover is free to flow laterally therefrom and as a result only that portion of the lubricant which is retained on said edge or surface primarily by surface tension and its adhesion thereto passes over the said edge or surface and to the valve stem engaging

end of the rocker arm. Generally speaking, the greater the length of the metering edge or surface employed the greater the cost of producing such an edge since more excess metal must be removed and since a greater degree of accuracy is required to maintain the width, W, within the necessary limits. Entirely satisfactory results have been obtained in producing and using metering edges having a length of approximately $\frac{1}{8}$ of an inch and a width varying between 0.025 and 0.035 of an inch.

It should be understood that although the invention has been shown as applied to the type of rocker arm generally employed on an overhead valve type of engine, the invention is not limited to this type of rocker arm as the invention is obviously applicable to any type of rocker arm having a valve actuating portion over which lubricant must flow in passing from the hub portion of the rocker arm to the valve stem engaging portion thereof. Moreover, the valve stem engaging portion of rocker arm may be provided with or shaped to provide a lubricant flow control or metering means other than the relatively long and narrow edge or surface herein shown and described and it should therefore be obvious that it is not intended to limit the invention to the exact details of construction and arrangements of parts herein shown and described as various modifications within the scope of the appended claims may occur to persons skilled in the art.

It is claimed and desired to secure by Letters Patent:

1. In an engine having a rocker arm, means for delivering lubricant to said rocker arm, and means for conducting a predetermined quantity of said lubricant to a part on said rocker arm which engages mechanism operatively associated therewith comprising a relatively narrow surface portion of said rocker arm over which lubricant flows in passing to said part and on which the lubricant flowing thereover is substantially solely retained by its surface tension and adhesion to said surface portion, said surface portion having an effective length width ratio such that said predetermined quantity of lubricant adheres thereto and flows thereover to the said part.

2. In an engine having a rocker arm, means for delivering lubricant to said rocker arm, and means for conducting a predetermined quantity of said lubricant to a part on said rocker arm which engages mechanism operatively associated therewith comprising a surface portion of said rocker arm over which lubricant flows in passing to said part and on which the lubricant flowing thereover is preponderantly retained by its surface tension and adhesion to said surface, said surface portion having an effective length-width ratio such that said predetermined quantity of lubricant adheres thereto and flows thereover to the said part.

3. In an engine, a rocker arm, mechanism operatively connected with a part of said rocker arm, means for flowing lubricant onto a portion of said rocker arm which is spaced from said part, and means for conducting a predetermined quantity of said lubricant from said portion to said part comprising an intermediate surface portion of said rocker arm having no appreciable impediment to the flow of lubricant from said surface in a direction which is transverse with respect to the direction the lubricant flows thereover in passing from said portion to said part, said surface having an effective length-width

ratio such that, primarily because of the surface tension of said lubricant and its adhesion to said surface, said predetermined quantity of lubricant flows over said surface and onto said part.

4. In an engine, a rocker arm, mechanism operatively connected with a part of said rocker arm, means for flowing lubricant onto a portion of said rocker arm which is spaced from said part, and means for conducting a predetermined quantity of said lubricant from said portion to said part comprising an intermediate surface portion of said rocker arm having no appreciable impediment to the flow of lubricant from said surface in a direction which is transverse with respect to the direction the lubricant flows thereover in passing from said portion to said part, said surface having a length greater than one-eighth of an inch and an effective length-width ratio such that, primarily because of the surface tension of said lubricant and its adhesion to said surface, said predetermined quantity of lubricant flows over said surface and onto said part.

5. In an engine, a rocker arm, mechanism operatively connected with a part of said rocker arm, means for flowing lubricant onto a portion of said rocker arm which is spaced from said part, and means for conducting a predetermined quantity of said lubricant from said portion to said part comprising an intermediate portion of said rocker arm presenting a relatively narrow and upwardly facing surface having no appreciable impediment to the flow of lubricant from said surface in a direction which is transverse with respect to the direction the lubricant flows thereover in passing from said portion to said part, said surface having an effective length-width ratio such that, primarily because of the surface tension of said lubricant and its adhesion to said surface, said predetermined quantity of lubricant flows over said surface and onto said part.

6. In an engine, a rocker arm, mechanism operatively connected with a part of said rocker arm, means for flowing lubricant onto a portion of said rocker arm which is spaced from said part, and means for conducting a prede-

termined quantity of said lubricant from said portion to said part comprising an intermediate portion of said rocker arm presenting a substantially flat and relatively narrow top surface over which lubricant flows in passing from said portion to said part, said surface having an effective length-width ratio such that, primarily because of the surface tension of said lubricant and its adhesion to said surface, said predetermined quantity of lubricant flows over said surface and onto said part.

7. In an engine, a rocker arm, mechanism operatively connected with a part of said rocker arm, means for flowing lubricant onto a portion of said rocker arm which is spaced from said part, and means for conducting a predetermined quantity of said lubricant from said portion to said part comprising an intermediate portion of said rocker arm presenting a substantially flat and relatively narrow top over which lubricant flows in passing from said portion to said part, said surface having a length greater than one-eighth of an inch and an effective length-width ratio such that, primarily because of the surface tension of said lubricant and its adhesion to said surface, said predetermined quantity of lubricant flows over said surface and onto said part.

8. An engine rocker arm comprising a hollow hub portion having a bore therein arranged to conduct lubricant from the interior of said hub portion to the outside surface thereof, and means for conducting a predetermined quantity of said lubricant from said outside surface to one end of said arm comprising an intermediate surface portion of said arm having no appreciable impediment to the flow of lubricant from said surface in a direction which is transverse with respect to the direction the lubricant flows thereover in passing from said hub portion to said one end, said surface having an effective length-width ratio such that, primarily because of the surface tension of said lubricant and its adhesion to said surface, said predetermined quantity of lubricant flows over said surface and on the said one end.

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